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Relationship between pheno-morphological traits with grain yield in promising lines of barley in Ardabil area

A. Khajavi[a], S. Aharizad[b], M. Ahmadizadeh[c*], H. Dalfardi[d]

[a] Department of Agronomy and Plant Breeding, Ardabil Branch, Islamic Azad University, Ardabil, Iran.
[b] Department of Agronomy and Plant Breeding, Faculty of Agriculture, University of Tabriz, Tabriz, Iran.
[c] Ph.D. Student in Plant Breeding, Sari Agricultural Sciences and Natural Resources University, Sari, Iran.
[d] M.Sc. Student of Horticulture, Jiroft Branch, Islamic Azad University, Jiroft, Iran.

Abstract

In order to study the relationship between traits and to determine the direct and indirect effects of effective traits on yield, an experiment based on randomized complete block design with three replications on 20 promising line of barley was carried out in Agricultural Research Station in Ardabil, Iran. Ten agronomy traits were measured in every plot by using 20 selective plants randomly. Analysis of variance indicated that there were highly significant differences among the lines in all of the traits except in infertile tiller trait. There were significant correlation between grain yield and all the studied traits except no. day to maturity. In regression analysis, fertile tiller, number of seeds per spike and plant height remained in final model ($R^2 = 0.905$). There was direct and positive effect on number of fertile tillers, number of seed per spike and plant height on grain yield. There was the most direct effect on number of seed per spike. The multiple statistical procedures used in this study showed that fertile tiller, number of seeds per spike and plant height were the most important yield variables. So, these traits could be used as selection criteria for increasing yield.

Keywords: barley, correlation, path analysis, promising lines, stepwise method.

Introduction

Barley with scientific name; *Hordeum Vulgare* is one of the oldest cereals cultivating in the moderate areas of the world (Babaiy *et al.,* 2011). Barley is the fourth most important cereal crop, cultivated successfully in a wide range of climate. This crop has potentials for growing under drought and saline condition. It requires less input like, fertilizer, irrigation and insecticides. Barley is increasingly being used as cattle feed in the world. The entire barley kernel is used as feed after grinding. Investigations of genetic variations have been conducted using the morphological traits and biochemical and genetical markers (Zaefizadeh *et al.,* 2011). Grain yield is a complex trait and is under effect of many physiological and morphological processes. Genetic structure of plant and interaction effect of their, effect on yield of agronomy plants (Monneveux and Belhassen, 1996). Yield is final result of all process which is involve in all growing steps of plant and every step could limit the yield of specific plant, none of the processes alone are not effective in increasing yield. Yield maybe is affected by other characteristics of different forms. For example, to direct effects of traits on yield, some of these traits applied indirect effect (Rahimian *et al.,* 1988). Usually, heritability of yield component is more than grain yield. There is often more heritability in thousand grain weight in comparison to other yield component. Controlling gens of yield component maybe have strong correlation and or result of effect of pleiotropic of

*Corresponding author's email: ahmadizadeh.mostafa@yahoo.com

Table 1. Analysis of variance for studied traits.

S.O.V	D.F	Means square									
		Days to flowering	Plant height	1000-seed weight	Infertile tiller	Fertile tiller	Seeds/spike	Harvest index	Days to mature	Straw yield	Grain yield
Replication	2	0.2 ^{ns}	0.0713 ^{ns}	0.129^{ns}	0.041 ^{ns}	0.030 ^{ns}	54.808*	4.758 *	0.117 ^{ns}	0.185 ^{ns}	2.210 *
Line	19	11.350 **	60.446 **	52.250 **	0.066 ^{ns}	0.543 **	70.748 **	9.744 **	2.368**	0.377 **	2.036 **
Error	38	1.568	0.270	0.427	0.079	0.040	12.345	1.165	0.152	0.068	0.562
CV	%	0.95	0.56	1.72	28.99	5.35	8.55	2.80	0.21	6.38	18.81

**,* and Ns, significant at 1 and 5% level of probability and non-significant, respectively.

different gens. Therefore, we selection each yield components in specific population, then we observe positive and negative reaction on other parts (Kjaer and Jensen, 1996). By evaluation number of tillers of wheat and barley in irrigation conditions and more yield selection is achieved of genotypes with high tiller, but in limit irrigation conditions are selected with fewer tillers (Innes *et al.,* 1985). It is clearly that cut of tillers is cause of decrease number of spike, but this reduction is compensable by increasing of yield in main stem, number of seed per spike and size of seeds increase in main stem by cutting of tiller. This result is agreement with the hypothesis that says tiller is comparative with main stem in early development (Yazdisamadi and Abd-Mishani, 2004). There is positive correlation between barley yield and fertile tiller and number of seed per spike, but there is little report about its relation to other traits such as thousand seed weight, spike length and plant height (Duggan *et al.,* 2000).

Mobasser *et al.* (2000) with path analysis of grain yield in barley and in order to determined the correlation between the number of dependent trait of yield and relation of cause and effect between them at 25 advance line of six rows barley during grow by using stepwise regression which is most suitable model for grain yield. Then, by path analysis between remained traits of model divide to direct and indirect effect by using the analyzing model. Number of seed per spike is most important effect on component of grain yield by attention to correlation and path analysis. Neyestani *et al.* (2005) by path analysis and estimating yield heritability and yield components on 10 barley showed that there was positive correlation between number of seed per spike and grain yield. One of the yield components is number of seed per spike and by increasing the number of seed per spike, yield will be increased. In addition, there was a positive correlation between the number of seed per spike and grain yield. According to the result of path analysis, number of seed per spike had the most direct on grail yield. The aims of the present study the relationship between traits, and to determine the direct and indirect effects of effective traits on yield.

Material and methods

This investigates was done at Agriculture Researches Station of Ardabil in 2009-10. Ardabil Researchers Station is located at 12 km to Ardabil road to Khalkhal by 1350 altitude, semiarid and cold weather by rain average of 15.8 and -1.9 c. we studied 17 promising line and three genotypes (control) of barley with three replication. The area of every plot was 6 lines with 20 cm space, 6m length and the area of every plot was 7.2 m^2 and harvesting was 6 m^2 which was plant by eliminating of 0.5 m at first and end of every field. Investigating traits of this study included the number of day to flowering, plant height, 1000 seed weight, number of infertile tiller, number of seed per spike, harvest index, number of day to maturity, straw yield and grain yield. Statistical analysis was obtained through the use of SPSS version 16 and Path analysis software's.

Results and discussion

Analysis of variance for all studied traits base on randomized complete block design with three replication showed that there were significant difference between studied lines from the view point of all traits except in the number of infertile tillers (Table 1). This significant difference means that there was variety genetic between lines. Therefore, in breeding programs there was probability use of variety to produce full harvest. Ahmadizadeh *et al.* (2011a) studying genetic diversity of durum wheat landraces from Iran and Azerbaijan reported highly significant differences among the genotypes in all of the morphological traits. Mollasadeghi *et al.* (2011), Molasadeghi and Shahryari, 2011 and Ahmadizadeh *et al.*

Table 2. Correlation coefficient between studied traits in 20 barley genotypes.

Traits	Days to flowering	Plant height	1000-seed weight	Infertile tiller	Fertile tiller	Seeds/spike	Harvest index	Days to maturity	Straw yield
Plant height	0.389	1							
1000 seed weight	-0.446*	-0.172	1						
Infertile tiller	0.431	0.734**	-0.123	1					
Fertile tiller	0.433	0.795**	-0.240	0.717**	1				
No. seed spike	0.523*	0.268	-0.901**	0.218	0.448*	1			
Harvest index	0.498*	0.005	-0.889**	-0.030	0.158	0.923**	1		
No. day to mature	0.97	-0.089	0.226	0.101	-0.076	-0.223	-0.219	1	
Straw yield	0.212	0.868**	-0.063	0.731**	0.886**	0.243	-0.110	-0.066	1
Grain yield	0.456*	0.727**	-0.590**	0.610**	0.835**	0.765**	0.495*	-0.170	0.797**

** and * significant at 1 and 5% level of probability.

(2011b) also reported similar results.

Simple correlation coefficient between investigated traits showed in Table 2. There was positive and significant correlation between grain yield with straw yield, number of day to flowering, fertile tiller, number of seed per spike, plant height and harvest index. Ghasemi-Kolkhoran (1996) showed that there was significant correlation between grain yield with number of seed per spike in six rows barley and Amini (2003) With studied on different varieties of barley, the highest correlation between grain yield and grain number per spike was observed. Mobasser *et al.* (2000) in order to determine the relation between some traits which is depend on yield and also relation of cause and effect between them in 25 advance lines of six rows barley and reported significant and positive correlation between 1000 seed weight and number of day to flowering with yield in barley. Fazel-Najafabadi *et al.* (2009) reported the correlation of grain yield with harvest index which was positive and significant. Jafarzadeh (2009) observed a significant, positive and simple correlation between grain yield and harvest index, by evaluating 25 cultivars and the promising line of Barely.

Regression and path analysis

In regression analyses using stepwise method, fertile tiller, number of seed per spike and plant height remained in final model, explaining 90.5% of variation in yield (R2 = 0.9). Considering the positive and significant regression coefficient of these traits, it could be stated that increasing the amount of these traits would increase the yield. Ahmadizadeh *et al.* (2011a) used stepwise regression analysis in 37 durum wheat genotypes, and showed that the grain yield period, the number of grains per spike and plant height remained in final model and were the most effective traits on grain yield. Efyoni and Mahloji (2005) in their research also found out that through number of seed per spike and plant height we could have some yield changes. Maas *et al.* (1996) through stepwise regression analysis in bread wheat showed that grain yield depends on the number of fertile tillers that are produced by each plant.

Path analysis show direct and indirect effects of cause variables on effect variables. In this method, the correlation coefficient between two traits is separated into the components which measure the direct and indirect effects (Farshadfar, 2004; Zakizadeh *et al.,* 2010).

In order to understand the causal relationships between the dependent variable (yield) on one hand and the variables that had significant effect on yield on the other hand, the path analysis were used. Results in Table 3 showed that the direct effect of three traits to model was positive (fertile tillers, number of seed per spike and plant height). The most direct effect had related to number of seed per spike and minimum positive direct had related to plant height. Indirect effect on the fertile tiller by plant height was more than indirect effect on the number of seed per spike by plant height. Indirect effect in plant height by fertile tiller was more than indirect effect of plant height by number of seed. Mobasser *et al.* (2000) recognized that number of seed per spike was most effective trait on grain yield by studying 25 advance lines of six rows barley. Neyestani *et al.*

Table 3. Direct and indirect effect on yield.

Traits	Direct effect	Indirect effect			Correlation with yield
		Fertile tiller	Seeds /spike	Plant height	
Fertile tiller	0.365	-	0.233	0.235	0.834**
No. seed spike	0.521	0.163	-	0.079	0.764**
Plant height	0.295	0.290	0.139	-	0.726**
Residual effects		0.282			

(2005) reported that number of seed had most direct effect on grain yield by studying 10 lines barley. There was more indirect effect of plant height by number of seed per spike than indirect effect of plant height by other traits.

Conclusion

In general, the results of the inferences are that the traits related to grain yield index can be important for the evaluation and improvement of barley genotypes in future. The results of correlation analysis concluded, that grain yield showed positive and significant correlation with all the studied traits except no. day to maturity. The multiple statistical procedures which were used in this study showed that fertile tillers, number of seed per spike and plant height were the most important yield, so these traits could be used for increasing yield. In general, it could be concluded that yield is a complex feature and in order to get more production and genetic improvement, the important factor which is the amount of hereditary traits must not also be ignored; moreover, the relation cognition should be done through regression and path analysis. In other words, the less common aspects of the traits, more successful the performance reform by means of the components will be.

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